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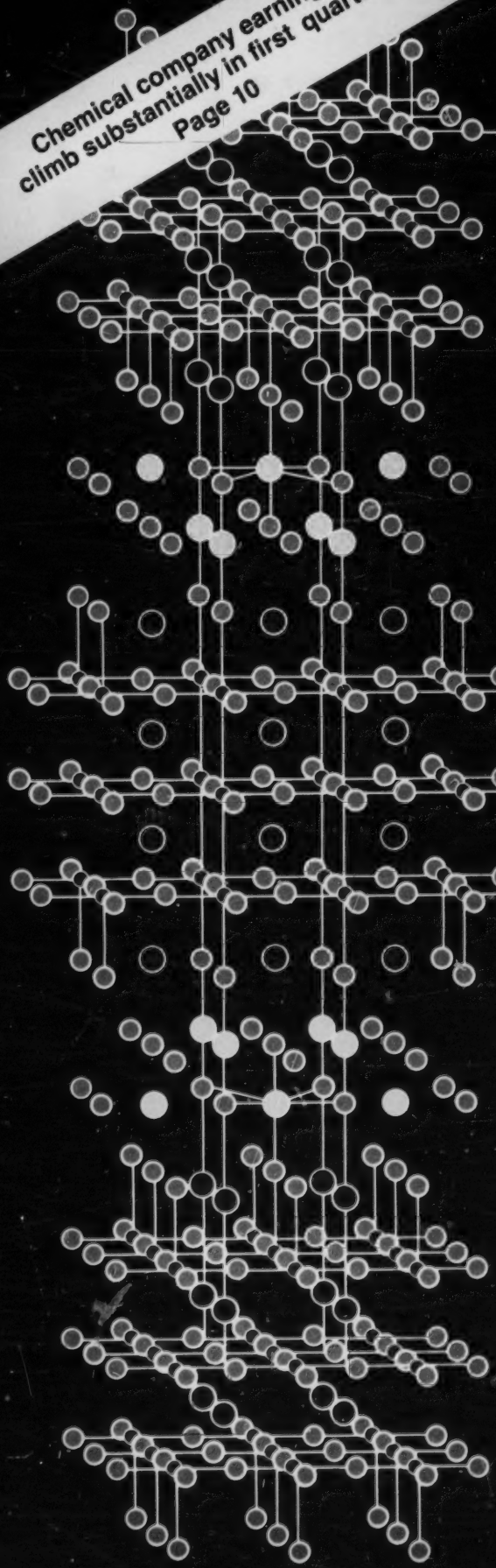
MAY 16, 1988

CHEMICAL & ENGINEERING

NEWS

Chemical company earnings climb substantially in first quarter
Page 10



Super-conductors

New structures lead to higher temperatures
Page 24

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CHEMICAL & ENGINEERING NEWS

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MAY 16, 1988

News of the Week

■ **May 5 explosion and fire at a Shell Oil refinery in Norco, La., eliminated 6% of U.S. ethylene capacity, further tightening supplies of this key chemical.** **Page 4**

■ **Recent destruction of one of only two U.S. plants that produce ammonium perchlorate oxidizer may cause supply shortages that could delay space shuttle and military missile programs.** **Page 5**

■ **Carbide-funded investigation by Arthur D. Little Inc. into the cause of the 1984 chemical disaster in Bhopal, India, supports Carbide's employee sabotage theory.** **Page 6**

■ **Dow Chemical is deeper into Italian chemical deals with its purchase of 5% stake in Montedison and involvement in a Montedison restructuring plan.** **Page 6**

Cover: Structure of 125 K superconductor $Tl_2Ca_2Ba_2Cu_3O_{10}$, as determined by Du Pont researchers. Thallium atoms are yellow, calcium purple, barium green, copper red, and oxygen blue

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Business

Earnings of major U.S. chemical companies soared 66% in the first quarter on sales rise of 20%. **Page 10**

Production of aerosol units increased 3.6% in 1987, marking the fifth consecutive year of growth for the industry. **Page 15**

Government

Bill banning polymer-based weapons not detectable by airport security systems was passed by the House last week in response to concerns about possible terrorist use of plastic guns. **Page 17**

Study contending that nitrates in acid rain adversely affect marine life raises environmental concerns in government and industry. **Page 19**

An international research program in genetics and neuroscience is being established by the Japanese. **Page 21**

Science

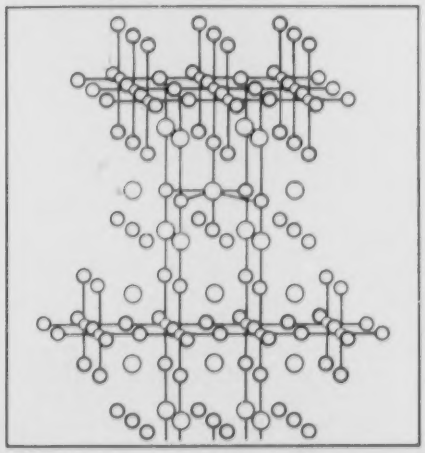
Berkeley chemist Peter G. Schultz wins NSF's prestigious Alan T. Waterman Award. **Page 29**

Education

NSF's directorate for science and engineering education is back at work supporting a number of important educational programs after having been eliminated in 1982 by Reagan Administration budget cuts. **Page 31**

ACS News

ACS Board approves 133 new or continuing Petroleum Research Fund grants totaling $3.6 million. **Page 34**



Cover Story

New superconducting materials that work at temperatures up to 125 K contain thallium or bismuth but no rare-earth elements. **Page 24**

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LETTERS

Fascinating superconductivity

SIR: I have never pretended any expertise in the field of superconductivity, but the continuing reports (C&EN, Sept. 21, 1987, page 33; Feb. 15, page 4; and March 14, page 4) keep fascinating, and I cannot resist offering my two cents worth.

I have been intrigued to discover that in all the yttrium, bismuth, and thallium compositions detailed, thus far, the copper atoms of oxidation state +2 have the expected partial positive charge, but those in oxidation state +3 bear partial negative charge. This seems somewhat unusual, but whether or not it bears any relationship to superconductivity remains to be determined. Since as yet no one really seems to know how superconductivity originates in these and similar compositions, this new information may provide a useful clue to other compositions that would also satisfy this criterion, and might or might not possess the desired property of superconductivity. There are many possibilities, not necessarily restricted to those containing copper.

R. T. Sanderson
Fort Collins, Colo.

The alternative doctorate

SIR: Slightly over a year ago C&EN published a letter of mine (March 16, 1987, page 33) that suggested the American Chemical Society institute an alternative doctorate to be granted to deserving researchers who meet certain reasonably stringent criteria. Kurt J. Rorig (C&EN, May 25, 1987, page 2) endorsed my proposal in concept, stating, "In my chemical career I have worked with a score of researchers who richly deserved, but did not have, the honor and prestige of a Ph.D." He pointed out, however, that the granting of doctorate degrees has historically been the province of universities and suggested that a Diplomate in Chemical Research (Dipl. C.R.) might be more appropriate.

Mario R. Altimura (C&EN, Nov. 23, 1987, page 2) also endorsed the need for some recognition for deserving non-Ph.D. researchers whom he characterized as "the unsung heroes of chemistry." Altimura recognized the importance of the term "doctor" and pointed out the distinction between a degree and a title. He suggested that ACS could quite properly grant a title such as Doctorate in Chemical Research (D.C.R.) to deserving individuals. In my original letter, I suggested D.Sc. in Chemistry or Doctor of Chemistry as alternatives to Ph.D., but I am equally comfortable with Altimura's suggestion.

A parallel indication of the need for some sort of recognition of successful non-Ph.D. researchers has been provided by the letters protesting J. R. Mohrig's comments (C&EN, Sept. 28, 1987, page 24) regarding the "amateur" status of "maverick" B.S. and M.S. chemists. A. A. Jeknavorian (C&EN, Dec. 7, 1987, page 46), for example, referred to "the unquestionable contribution that non-Ph.D. chemists have made to the field of chemistry." It is clear that many chemists recognize the contributions of their non-Ph.D. colleagues. It is also clear that, unless a device is established for granting a doctorate to those whose performance has demonstrated that they fully deserve one, these individuals will continue to be viewed by many as second-class chemists—if not amateurs or mavericks.

This brings me to the recent letter by Robert M. Kuhn (C&EN, March 7, page 4). Kuhn states: "The doctorate carries with it the implication that the recipient not only can do original research but is willing to sacrifice nearly everything for it: six to eight years of practically uncompensated labor . . . and a near total lack of family life." He concludes: "For a similar contribution anyone can have the real thing." Kuhn makes a doctorate sound like an endurance prize available to anyone willing to work hard and make unreasonable sacrifices.

Although success in chemistry—as in any worthwhile endeavor—does require hard work and some sacrifices, these should not be ritualized into a form of hazing that would-be initiates must endure to gain acceptance. Chemistry is a profession and not a fraternity. Nevertheless, Kuhn has identified the principal reason why many good researchers have elected to bypass a traditional doctorate. Many intelligent, hard-working chemistry graduates simply are unwilling to submit to "six to eight years of practically uncompensated labor" and "a near total lack of family life." They are willing to work hard, and capable of doing so productively, but they wish to have a family life and must earn a living wage. When such chemists have demonstrated through their work a competence equal to that we expect of holders of a doctorate, they should be able to attain the recognition, prestige, and compensation that a doctorate confers. They should not be punished for having attained and demonstrated their competence via an alternative route.

David R. Schryer
Hampton, Va.

Chemical Earnings Continue Big Gains in First Quarter

Composite profits of 30 major U.S. chemical firms climbed 66% on sales up 20%; income of oil, diversified producers also rose, but less markedly

Marc S. Reisch, C&EN New York

Chemical industry sales and earnings continued to climb in the first quarter of 1988, building on the momentum achieved last year. According to composite results of a representative group of the largest U.S. chemical companies, profits rose a heady 66% over the same period in 1987. Earnings also increased at diversified companies that are producers of chemicals, but not quite so dramatically.

Earnings of oil companies charted by C&EN also rose in the first quarter as prices for oil and their refined fractions were higher than the year-earlier quarter. And because of the good climate for chemical sales, earnings for the chemical operations of oil companies increased significantly over the same period last year.

Chemical operations excel at oil companies

$ Millions	First-quarter earnings on chemical operations[a] 1988	1987	% change
Amoco	$169	$ 88	92%
Chevron	109	52	110
Exxon	308	186	66
Mobil	134	43	212
Shell	143	40	258
Texaco	47	8	488
TOTAL	$910	$417	118%

a After-tax earnings.

Sales and earnings of the chemical industry continue to grow at a phenomenal pace, setting the stage for another record year for the industry. Last October, observers thought that the industry might suffer following the stock market crash. Market uncertainty at the time led observers to believe that the outlook for 1988 might not be very good.

However, record fourth-quarter sales followed by almost equally strong first-quarter sales have shown that the sales and earnings momentum behind the chemical industry still has a lot of steam. Demand for commodity petrochemicals in particular is strong, straining capacity and forcing price increases.

The industry has increased its first-quarter output 9% from the year-earlier quarter, mostly via debottlenecking, rarely through the addition of new plant capacity. With the memory of plant shutdowns in the late 1970s and early 1980s still fresh, industry executives are reluctant to repeat the mistake of overbuilding capacity.

With capacity tight in most major chemical arenas, the Commerce Department reported that prices in the chemical and allied industries were 7.4% higher in the first quarter than the same period in 1987. And inasmuch as energy and feedstock prices remained fairly stable throughout the quarter, profit margins have risen considerably for most of the chemical industry. For the 30 largest chemical companies tracked by C&EN, after-tax earnings as a percentage of sales increased to 8.9%

Chemical industry leaders for the first quarter

Sales: Rank 1988		$ Millions	Rank 1987
1	Dow Chemical	$3981.0	1
2	Monsanto	2127.0	2
3	Union Carbide	1947.0	3
4	W. R. Grace	1297.0	5
5	American Cyanamid	1148.5	4
6	Quantum Chemical	832.9	7
7	Hercules	661.6	6
8	Rohm & Haas	620.5	8
9	Air Products	618.9	9
10	B. F. Goodrich	588.0	11

Earnings[a]	$ Millions	Rank 1987
Dow Chemical	$507.0	1
Monsanto	210.0	2
Arco Chemical	108.0	5
Union Carbide	101.0	3
Quantum Chemical	100.5	10
American Cyanamid	79.2	4
Rohm & Haas	62.2	6
Air Products	55.7	9
Ethyl	53.1	8
Hercules	39.8	7

Profitability	Earnings as % of sales	Rank 1987
Arco Chemical	18.5%	2
Georgia Gulf	17.4	14
International Flavors	16.0	1
Vista Chemical	15.4	11
Dow Chemical	12.7	8
Quantum Chemical	12.1	22
Ethyl	11.1	3
Nalco Chemical	10.6	7
Betz Laboratories	10.6	4
Rohm & Haas	10.0	5

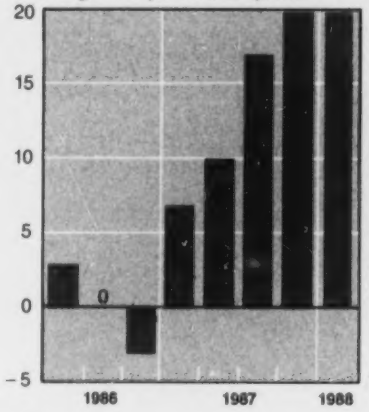
Note: For 30 chemical companies listed on page 12. a After taxes.

Chemical industry 1988 first-quarter results

- **Sales climbed 20%**
- **Earnings jumped 66%**
- **Profit margins neared 9%**
- **Production rose 9%**
- **Prices increased 7.4%**

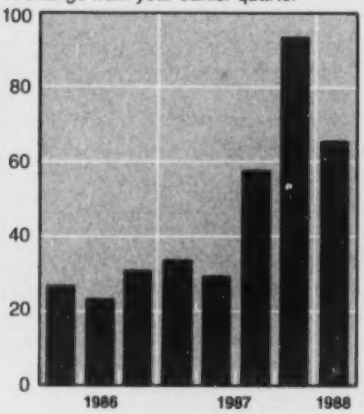
Sales

% change from year-earlier quarter



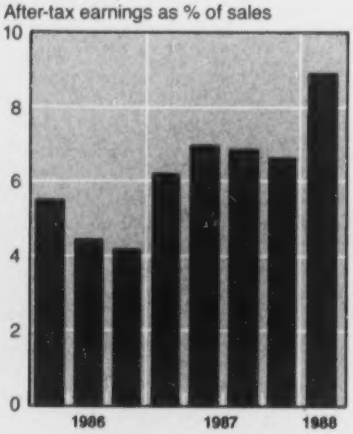
Earnings

% change from year-earlier quarter



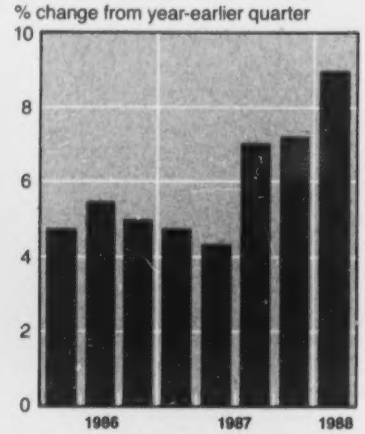
Profit margins

After-tax earnings as % of sales



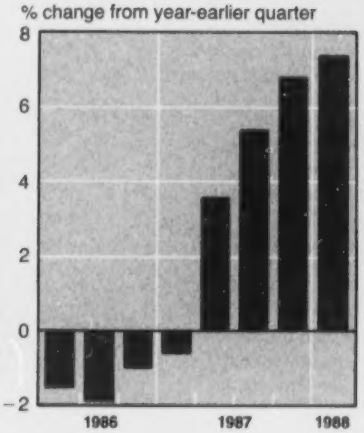
Production

% change from year-earlier quarter



Prices

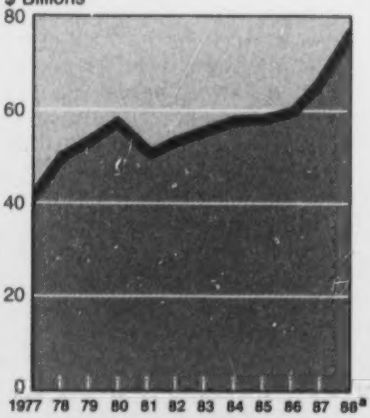
% change from year-earlier quarter



Sales in 1988 will increase about 15% and earnings will climb 35%, hiking profit margins to 7.9%

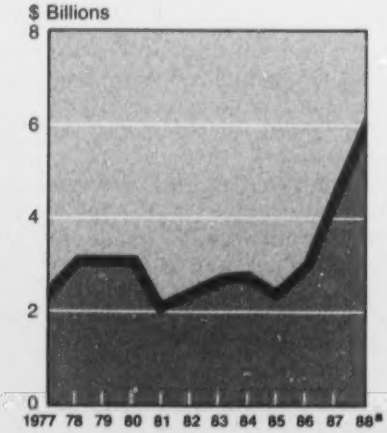
Annual sales

$ Billions



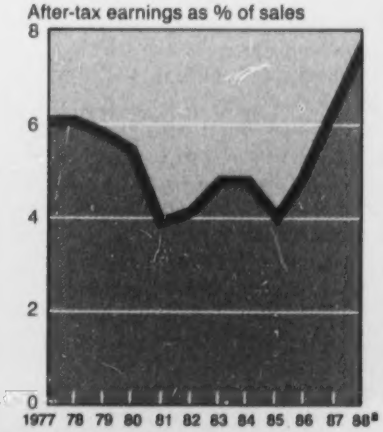
Annual earnings

$ Billions



Annual profit margins

After-tax earnings as % of sales



Note: All sales, earnings, and profit-margin data are based on combined results of 30 companies listed on page 12. **a** C&EN estimates.

Earnings and profit margins increased dramatically in first quarter

	FIRST-QUARTER 1988						12-MONTH RUNNING DATA			
	Sales	Earnings[a]	Change from 1987		Profit margin[b]		Change from 1987		Profit margin	
	($ millions)		Sales	Earnings	1988	1987	Sales	Earnings	1988	1987
Air Products[c]	$ 618.9	$ 55.7	17%	36%	9.0%	7.8%	11%	31%	8.4%	7.1%
American Cyanamid[c]	1,148.5	79.2	13	29	6.9	6.1	10	23	6.3	5.6
Arco Chemical[c]	583.0	108.0	30	83	18.5	13.1	30	79	14.7	10.6
Aristech	260.3	22.7	25	67	8.7	6.5	27	58	8.1	6.5
Betz Laboratories	105.8	11.2	19	15	10.6	11.0	−6	−22	4.2	5.1
Cabot[c]	465.9	18.4	23	−5	3.9	5.1	1	17	5.2	4.5
Chemed	99.7	4.5	9	6	4.6	4.7	5	44	5.3	3.8
Crompton & Knowles	63.6	3.6	14	51	5.6	4.2	24	85	10.5	7.0
Dow Chemical[c]	3,981.0	507.0	32	106	12.7	8.2	14	9	11.0	11.6
Ethyl[c]	480.1	53.1	23	14	11.1	11.9	25	359	6.3	1.7
First Mississippi	62.3	1.2	−13	−47	2.0	3.3	21	36	4.1	3.6
H. B. Fuller	154.6	4.7	13	30	3.1	2.7	−2	189	5.0	1.7
Georgia Gulf	221.9	38.6	44	268	17.4	6.8	108	336	14.8	7.1
B. F. Goodrich[c]	588.0	25.0	21	558	4.3	0.8	15	18	10.4	10.2
W. R. Grace[c]	1,297.0	38.7	35	231	3.0	1.2	28	52	12.1	10.2
Hercules[c]	661.6	39.8	−1	−17	6.0	7.1	27	def	3.5	def
International Flavors	224.0	35.9	25	30	16.0	15.4	2	−4	7.4	7.9
International Minerals	322.8	32.0	−29	72	9.9	4.1	21	27	14.6	14.0
Loctite	108.9	10.5	21	21	9.6	9.7	4	def	5.3	def
Lubrizol	293.2	19.0	8	−14	6.5	8.1	28	32	9.6	9.3
Monsanto[c]	2,127.0	210.0	14	52	9.9	7.4	6	−11	6.2	7.4
Nalco Chemical	236.0	25.0	20	38	10.6	9.2	13	58	6.4	4.6
Olin[c]	567.0	29.0	14	19	5.1	4.9	16	44	9.8	8.1
Pennwalt	328.4	13.7	24	7	4.2	4.9	17	60	4.1	3.0
Petrolite	79.5	4.7	24	16	5.9	6.3	11	7	4.4	4.5
Quantum Chemical[c]	832.9	100.5	27	248	12.1	4.4	10	3	5.5	5.8
Rohm & Haas[c]	620.5	62.2	16	17	10.0	10.0	21	169	7.8	3.5
Union Carbide[c]	1,947.0	101.0	16	53	5.2	3.9	11	7	8.7	9.1
Vista Chemical	215.6	33.3	42	196	15.4	7.4	12	69	3.7	2.5
Witco[c]	393.9	20.0	18	51	5.1	4.0	11	14	4.9	4.8
Total 15 larger firms	**$16,241.1**	**$1459.5**	**20%**	**69%**	**9.0%**	**6.4%**	**15%**	**61%**	**7.3%**	**5.2%**
Smaller 15 firms	**$ 2,847.7**	**$ 248.5**	**21%**	**51%**	**8.7%**	**7.0%**	**18%**	**67%**	**8.1%**	**5.7%**
GRAND TOTAL	**$19,088.8**	**$1708.0**	**20%**	**66%**	**8.9%**	**6.5%**	**16%**	**62%**	**7.4%**	**5.3%**

a After-tax earnings from continuing operations excluding significant nonrecurring and extraordinary items. b After-tax earnings as a percentage of sales. c One of the 15 largest companies. def = deficit.

in the first quarter, up from 6.5% in the year-earlier quarter.

Demand for chemicals has increased not only within the U.S. but globally. Most companies cited strong earnings in foreign countries as well as increases due to the effect of currency translations because of the weak U.S. dollar as a factor in their first-quarter profitability. In addition, the Commerce Department continues to cite figures that show a trade balance continuing to grow in favor of the U.S.

Domestically, however, there are still some weak spots. According to Commerce, new housing permits continue to decline as they did throughout last year. Interest rates have begun to inch up, a move that does not favor a near-term improvement in the housing industry, and may presage a slowdown later in the year.

Commerce figures also indicate that auto output continues to decline and that dealer inventories remain high. As a result chemical sales to auto makers may continue to dampen. One bright note, however, are plans by Chrysler, Ford, and Japanese auto makers with U.S. production facilities to export autos made in the U.S. to foreign markets.

Agricultural chemical markets remain weak. Though they are down from 1987 levels, fertilizer materials continue to be in oversupply.

Despite these few drawbacks, the 30 chemical companies charted by C&EN registered composite earnings in the first quarter of $1.71 billion, up 66% from first-quarter 1987 on a sales boost of 20% to $19.1 billion.

On a quarter-to-quarter basis, combined earnings for the 30 companies climbed 50% in the first quarter from a strong fourth quarter in 1987. Composite sales were up 13% from the fourth quarter of last year. The first-quarter profit margin average of 8.9% was the highest recorded in the past two years.

Sales of the 15 larger chemical

companies grew 20%, compared with 21% for the smaller 15 companies, from the year-earlier quarter. The larger, more diversified firms continued to outperform the smaller companies in profitability. For the 15 larger firms, composite earnings climbed 69% to total $1.46 billion on sales of $16.2 billion. Profit margins for the first quarter for the 15 firms averaged 9% compared with 6.4% in the first quarter of 1987.

For the 15 smaller companies, first-quarter earnings increased a composite 51% from last year's first quarter to $249 million on sales of $2.85 billion. Profit margins at the smaller companies averaged 8.7% in the first quarter of this year compared with 7.0% in the same quarter in 1987.

Higher operating rates and strong worldwide demand accounted for the strong performance by Du Pont, the largest U.S. chemical producer. According to chairman Richard E. Heckert, "The solid gain in first quarter performance reflects continued strong worldwide demand and further progress in reducing costs and improving overall efficiency." He says that the improvements in first-quarter earnings were led by the industrial chemicals and polymer products segment. In addition, an improvement in global demand for agricultural chemicals helped lift that segment out of the doldrums.

For Dow Chemical, whose earnings were up a whopping 106%, president and chief executive officer Frank P. Popoff says that "increases in both prices and volume contributed to the first-quarter results." He notes that basic chemicals and plastics, which continue to be the foundation of Dow's business, had a record-setting quarter. "Costs remain stable, volume has increased, and there is no weakness apparent in either the product lines or geographical areas," Popoff says. "We are experiencing strong demand globally in these basic products, and, although the growth rates may moderate in 1989, we anticipate continued growth into the 1990s," he adds.

Strong demand also contributed to Monsanto's excellent results in the first quarter. The company registered a 52% increase in its profits from last year's first quarter. Richard J. Mahoney, Monsanto chairman and chief executive officer, says, "Chemicals had excellent sales and operating income from strong demand for its major products and very high capacity utilization."

The Monsanto chief executive also noted the contribution of strong overseas sales to the corporation's bottom line. "Sales and operating income outside the U.S., both from exports and non-U.S. production, substantially exceeded levels in 1987." He adds that "higher margins on key products are expected to continue this year because of strong worldwide demand and some announced price increases."

The strength of the international market was evident again in remarks by Allen F. Jacobson, chairman and chief executive officer of 3M. "Earnings benefited from double-digit worldwide unit growth, increased productivity, weakening of the U.S. dollar, and a lower effective tax rate." Jacobson says that the strength of the company's business overseas was not due only to favorable currency exchange rates. He points out that the company's unit volume sales outside the U.S. grew about 15% and that international sales exceeded $1 billion for the first time in any quarter. "Our efforts to increase penetration of international markets continue to show positive results," he adds.

Strong global markets helped PPG Industries weather a weak U.S. housing and auto market. "One result of our strategic emphasis on globalization," says board chairman Vincent A. Sarni, "is that lower North American auto production and housing

Sales, earnings up for most oil and diversified companies

	FIRST-QUARTER 1988					
	Sales ($ millions)	Earnings[a]	Change from 1987 Sales	Change from 1987 Earnings	Profit margin[b] 1988	Profit margin[b] 1987
OIL AND GAS COMPANIES						
American Petrofina	$ 604.7	$ 30.4	12%	53%	5.0%	3.7%
Amoco	5,761.0	469.0	10	80	8.1	5.0
Ashland[c]	1,945.8	20.6	20	2790	1.1	0
Chevron	7,500.0	442.0	10	68	5.9	3.9
Exxon	22,008.0	1,455.0	13	36	6.6	5.5
Kerr-McGee	663.8	10.3	21	−49	1.5	3.7
Mobil	13,800.0	505.0	18	107	3.7	2.1
Occidental Petroleum	4,476.0	111.0	8	52	2.5	1.8
Phillips Petroleum	2,900.0	103.0	14	def	3.6	def
Shell Oil	5,051.0	345.0	12	219	6.8	2.4
Sun Co.	2,390.0	60.0	6	58	2.5	1.7
Texaco	3,330.0	242.0	18	105	7.3	4.2
DIVERSIFIED MANUFACTURERS						
Allied-Signal	2,942.0	112.0	12	10	3.8	3.9
Borden	1,602.3	52.4	12	19	3.3	3.1
Du Pont	7,992.0	590.0	12	51	7.4	5.5
Eastman Kodak	3,328.3	260.1	25	46	7.8	6.7
Engelhard	511.4	13.4	−5	−1	2.6	2.5
FMC	713.9	24.2	−1	−4	3.4	3.5
Ferro	241.2	11.2	18	65	4.6	3.3
GAF	216.5	21.8	13	6	10.1	10.8
Koppers	306.7	−4.4	13	def	def	def
3M	2,602.0	277.0	18	30	10.6	9.7
Morton Thiokol	604.4	41.5	16	14	6.9	7.0
PPG Industries	1,373.0	118.6	9	36	8.6	6.9
Tyler	292.9	1.7	14	69	0.6	0.4
Vulcan Materials	202.7	15.6	20	48	7.7	6.2

a After-tax earnings from operations excluding significant nonrecurring and extraordinary items. b After-tax earnings as a percentage of sales. c Includes some nonrecurring or extraordinary items. **def** = deficit.

Pharmaceutical earnings rose markedly in first quarter

Combined first-quarter earnings of 13 pharmaceutical companies tracked by C&EN amounted to $1.82 billion, a 14% rise over the year-earlier quarter.

Combined sales for the companies totaled $13.2 billion, up 15%. Collectively, the companies recorded a profit margin (after-tax earnings as a percentage of sales) of 14%, the same as in first-quarter 1987. This group has consistently reported profit margins in excess of either the chemical, diversified, or oil and gas companies surveyed by C&EN.

Like these other groups, the pharmaceutical group benefited from the improvement of foreign business and the resultant overseas currency translation bonus attributed to the weaker U.S. dollar. Highly dependent on new product development to drive both sales and profitability, most pharmaceutical firms brought new products to market last year and this was reflected in the higher sales and earnings they registered for the quarter.

Merck, whose earnings rose 35% in the quarter on a 29% sales gain, had strong unit volume gains both in its domestic markets and international operations. According to chairman P. Roy Vagelos, "Sales outside the U.S. accounted for 51% of first-quarter sales, compared with 49% for the same period last year." He says that Merck's "income growth and improved earnings margins resulted from strong unit volume gains, a better product mix, the continuation of cost controls, and productivity improvements as well as the favorable effect of exchange."

SmithKline Beckman's chairman and chief executive officer Henry Wendt also notes the improvement in his company's sales and profit picture as a result of currency translations. The weaker U.S. dollar, he points out, had the effect of adding $55 million to corporate sales. SmithKline's after-tax earnings were $167 million in the first quarter, up 14% over the year-earlier period.

Pfizer attributes its strong 47% earnings rise to strong sales in all five of its business segments. Its pharmaceutical sales increased 16%, says company chairman Edmund T. Pratt Jr. Sales in other divisions were up as well. Specialty chemical sales of Pfizer increased 17%, material sciences sales 18%, agricultural sales 15%, and consumer sales 17%, he says.

Given the strong market and Pfizer's confidence in developing new products for its markets, Pratt adds that products developed via R&D "combined with strong sales in our current product lines have positioned Pfizer well to meet its long-term growth objective of at least 10 to 15% earnings growth per year."

Upjohn, too, noted the strength of foreign markets. Company chairman and chief executive officer Theodore Cooper says that foreign sales increased 18% and amounted to 40% of consolidated sales. The 11% sales increase for the first-quarter of 1988, he says, was due to a 6% increase in volume, a 1% increase in price, and a 4% increase from foreign currency fluctuations.

Schering-Plough's chairman and chief executive Robert P. Luciano says that higher sales and earnings in the first quarter were the result of continued gains by the company's worldwide pharmaceutical business and a solid performance by the company's U.S. consumer operations. Earnings of the company rose 20% on a 10% gain in sales. Luciano forecasts earnings increasing about 25% for 1988.

Like the chemical, diversified, and oil companies charted by C&EN, pharmaceutical companies are benefiting this year from lower corporate tax rates. Schering-Plough, for instance, forecasts its rate will be 2% below that of 1987.

	FIRST-QUARTER 1988					
	Sales ($ millions)	Earnings[a]	Change from 1987 Sales	Change from 1987 Earnings	Profit margin[b] 1988	Profit margin[b] 1987
Abbott Labs	219.3	8.4	9	13	3.8	3.7
American Home Products	$1,412.6	$237.1	10%	10%	16.8%	16.8%
Baxter Travenol	1,635.0	91.0	12	38	5.6	4.5
Becton Dickinson	463.5	38.9	19	17	8.4	8.5
Bristol-Myers	1,520.0	210.6	13	−25	13.9	20.8
Eli Lilly	1,072.1	233.2	11	15	21.8	20.9
Merck	1,436.8	271.4	29	35	18.9	18.1
Pfizer	1,297.9	196.3	16	47	15.1	11.9
Schering-Plough	752.5	101.5	10	20	13.5	12.4
SmithKline Beckman	1,162.4	166.5	16	14	14.3	14.6
Squibb	596.9	90.9	27	31	15.2	14.8
Upjohn	662.4	95.4	11	18	14.4	13.5
Warner Lambert	927.8	83.5	14	14	9.0	9.0
TOTAL	$13,159.2	$1824.7	15%	14%	13.9%	13.9%

a After-tax earnings from operations excluding significant nonrecurring and extraordinary items. b After-tax earnings as a percentage of sales.

starts did not impede PPG's ability to achieve substantial growth." Sarni attributes PPG's 36% earnings growth in the first quarter to "strong chemical and glass fiber results, as well as substantial performance gains by European operations coupled with favorable currency translations."

Koppers, which recorded a 13% sales increase in the quarter compared with the year-earlier period, had an overall earnings decline of 4.4%. The company would have shown a profit, however, if it were not for exceptional charges against earnings. "We had an abnormal increase of nearly $7 million in our corporate overhead as the result of expenses that were external to our first-quarter performance," says company chairman Charles R. Pullin. "Most significant were expenses related to the hostile tender offer led by Beazer . . . and Shearson Lehman Hutton." However, Koppers' operating income in chemicals and allied products rose more than 34%, and losses in construction materials and service were limited compared with the year earlier, he says. □

New acid rain study stirs interest, concern

Lois R. Ember, C&EN Washington

Among the slew of studies on acid rain, a recent one highlighting a not-so-new but often overlooked aspect of the problem—the nutrient effect of nitrate deposition on marine life—has been stirring vast interest, if not concern, in some quarters.

Members of Congress have cited it in their calls for acid rain control programs. A powerful member of the House of Representatives has asked the Environmental Protection Agency to review it. And some observers have even suggested that it has the potential for dislodging the logjams holding up action on acid rain control bills in both houses of Congress.

This is powerful stuff for a study that breaks little new ground scientifically. What the Environmental Defense Fund has done in its report, "Polluted Coastal Waters: The Role of Acid Rain," is to move the acid rain debate beyond the issues of damage to freshwater bodies and forests. By calculating the effect of acid deposition on estuaries along the eastern coast, particularly the Chesapeake Bay, EDF has focused the spotlight on acid rain's effect on marine ecosystems.

As one electric utility scientist explains, the EDF effort links atmospheric deposition with aquatic nutrient effects. "The idea that nitrate in acid rain might add to the nutrient loading of estuaries is not a new hypothesis. We just went ahead and did the calculations," EDF staff scientist Diane C. Fisher admits. Though not new, "the idea has been largely overlooked by managers at state and federal levels who are called upon to develop programs to manage estuaries," she says.

Using data collected by EPA's Chesapeake Bay Program, the National Atmospheric Deposition Program, and state agricultural agencies, EDF has concluded that the nitrate component of acid rain is significant enough to adversely affect the vitality of the Chesapeake Bay, which is a rich spawning ground for marine life. From calculations based on the data, EDF figures that fully 25% of the nitrogen loading of the bay comes from atmospheric deposition of nitrate in acid rain. As a source of nitrogen to the bay, acid rain is exceeded only by nitrogen from fertilizers.

EDF is not considering nitrate's contribution to the acidity of the bay, but rather its nutrient effect. That is, deposited nitrate encourages the vigorous growth of algae. Algae blooms choke life from the bay by using up its oxygen and screening out its sunlight. Therefore, the bay's ecosystem becomes unbalanced and marine life is adversely affected.

According to Steven P. Lindenberg, the Electric Power Research Institute's manager of technology transfer, "EDF's approach is reasonable and the methodology is not flawed, but the report does not consider all the aspects it should have." An industry source says a major flaw in EDF's analysis is that it does not include an evaluation of the bay's own contribution to its nitrogen loading. The bay's sediment is rich in nitrogen and phosphorus. When stirred, this sediment becomes a major source of nitrogen to bay waters.

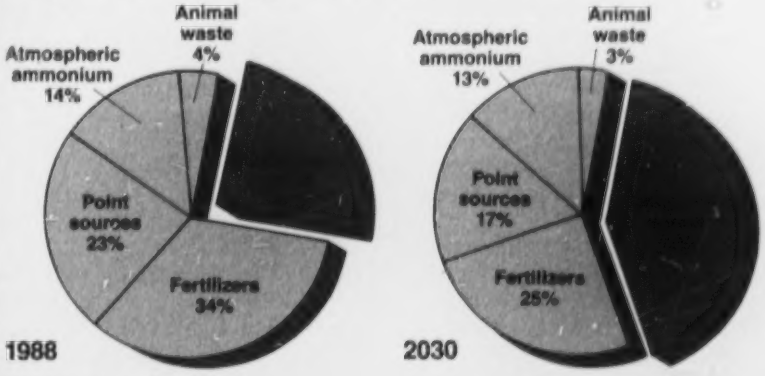
An EPA scientist who is reviewing EDF's study says, "It is not as rigorous as it should be." Further, he says, "EPA has a program in place—the Chesapeake Bay Program—to study the issue," which he feels probably would be worth looking at in more detail.

EPA's review of the EDF study was prompted by a request from Rep. John D. Dingell (D.-Mich.), the powerful chairman of the House Energy & Commerce Committee. Dingell, who represents the automotive center of Michigan, has long resisted passage of acid rain legislation.

Dingell is obviously concerned about the implications of the EDF study or he wouldn't have requested the review, a House committee staffer says. The reason for his concern is the source of nitrate in acid rain: nitrogen oxide emissions from the burning of fossil fuels in vehicles and electric power plants.

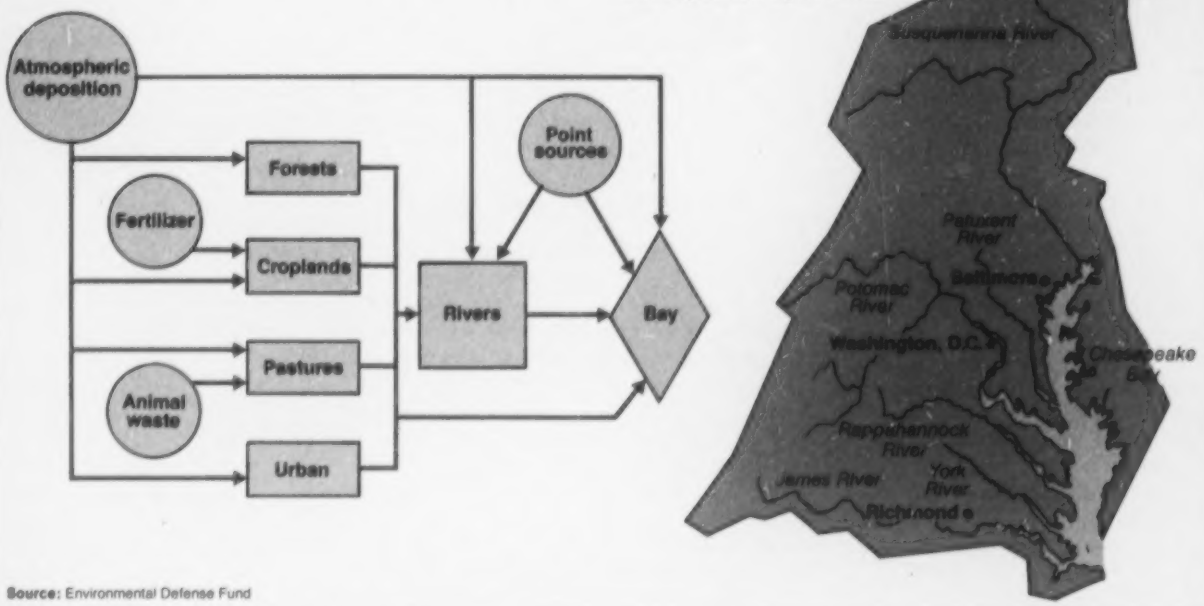
EPA will complete its review by the end of the month. It is likely to come down hard on the EDF study. Outside experts reviewing the study for EPA have mentioned several flaws in EDF's reasoning. One of the major ones, according to a knowledgeable source, is that EDF assumes that all of the nitrogen falling in the Chesapeake Bay watershed, which is largely terrestrial, enters the bay's waters. Nitrogen input to the watershed from acid rain is significant, but according to the reviewers, only a small fraction of this nitrogen actually reaches the bay.

Atmospheric sources of nitrate to Chesapeake Bay likely to increase by year 2030



Source: Environmental Defense Fund

Nitrogen flow in the Chesapeake Bay watershed



Source: Environmental Defense Fund

EDF scientist Fisher disputes this assessment. "We did take into account the nitrogen retention of the watershed," she says. The percentage contribution of atmospheric nitrogen to the nitrogen loading of the bay is 25% now and could increase to 42% by 2030 if federal nitrogen oxide standards are not tightened, she says. These percentages are calculated by using a watershed retention factor, Fisher explains. Further, she adds, "A significant amount of nitrogen reaches the bay from rainfall directly."

While the scientists battle over the science, politicians feel free to use EDF's conclusions. Speaking from the House floor, Rep. Marge Roukema (R.-N.J.) implored her colleagues on the Energy & Commerce Committee to "pass a Clean Air Act overhaul this year to eradicate the environmental scourge that is acid rain." Why now? Because, she said, "Recent reliable statistics point for the first time to evidence that acid rain is now a major threat to marine life in Atlantic coastal waters."

In his recent address to Congress, Canadian Prime Minister Brian Mulroney said: "The one thing acid rain does not do is discriminate. It is despoiling your environment as inexorably as it is ours. It is damaging your environment from Michigan to Maine, and threatens marine life on the eastern seaboard."

Ross Glascow, first secretary at the Canadian Embassy in Washington, D.C., says Canadian scientists have not yet reviewed the EDF study. Still, he says, "It is one more study, one more piece of information showing a new element of the problem. And it cannot but help reinforce the need for action."

A House committee staffer agrees. The environmental group's findings "affect a different constituency—people who like to sail and fish—so they broaden the community of interest." He adds that the "potential political implications are very significant, but it's too early to say what they might be."

Some Congressional observers say the report's conclusions put added pressure on Congressmen representing states that are part of the Chesapeake Bay's watershed. Senate majority leader Robert C. Byrd (D.-W.Va.), to the frustration of many of his Democratic colleagues, has prevented acid rain legislation from reaching the Senate floor. He has done so because he represents a state that would have to severely control electric power plant emissions, a state with a major coal mining industry. The problem is that West Virginia coal is high in sulfur, which contributes to acid rain. The senior Senator from Virginia, Republican John W. Warner, has voted against acid rain control legislation. EDF's report could force Byrd's hand in bringing bills to the floor, and could compel Warner, whose state borders the bay, to vote for the measure.

A lot of the resistance to control measures is economically based. As Prime Minister Mulroney noted in his address to Congress: "I will admit without hesitation that the cost of reducing acid rain is substantial, but the cost of inaction is greater still."

The Congressional Research Service and EPA have analyzed the costs of compliance with the acid rain provisions in S. 1894, introduced by Sen. George J. Mitchell (D.-Me.) and currently awaiting

floor action in the Senate. Depending on the baseline chosen for analysis, CRS pegs the cost of Mitchell's acid rain provisions at $0 to $8 billion per year by 2000. For example, if EPA, as it has the authority to do under the current Clean Air Act, implements more stringent sulfur dioxide and nitrogen oxide standards, then the cost of complying with Mitchell's bill would be $0 per year. If, however, EPA fails to modify its clean air rules to implement stricter regulations, then the cost of complying with Mitchell's bill would be $8 billion. EPA estimates, using two different models, range from $2 billion to $14 billion per year by the year 2010.

Larry Parker, CRS specialist for energy policy, says that "EPA's costs for the year 2000 are the same as CRS's—$6 billion to $8 billion per year—if existing Clean Air Act regulations remain in place until 2000." EPA, however, projects to the year 2010. "We think projecting to 2010 is stretching the analysis," Parker says.

Industry analyses tend toward the upper end of EPA's estimates. But they, like EPA, fail to calculate the benefits from controlling acid rain. CRS estimates benefits at between $5.5 billion and $8.2 billion, mainly to urban areas. □

Japan sets up program for biological research

Japanese officials have put final touches on plans for a global biological research program, called the Human Frontier Science Program, that they hope will launch their country into a new era of international science. Japan will establish a nongovernmental secretariat for the program and will manage it through an international governing council. Almost all the funding in the countries involved—Japan, the U.S., Canada, and the European Community countries—will be provided by Japan, at least at first.

In its present design, the program consists of two thrusts—one in the neurosciences with emphasis on brain function, the other on the chemistry and molecular biology of gene expression. The program in the first year would consist of 30 to 50 direct research grants to researchers working in teams, 100 to 200 postdoctoral fellowships, and 10 to 20 workshops. Young researchers would be favored for funding. The average annual grant size would total $500,000, and postdoctoral awards would average $50,000.

Although the sums are minor as far as international programs go, the Japanese have ambitions for the program that project far into the future. In their final document—issued last month—they see the program as creating "a new science and technology system based on complete harmony between nature and mankind." They hope the program's results will form the bases of revolutionary information technologies and techniques for disease prevention and treatment. The ultimate conceptual goal, however, is to relate molecular phenomena to the functioning of entire organisms.

The Japanese are eager to have the program placed on the official agenda for formal discussion at the economic summit meeting next month in Toronto. Although American sources believe it will not receive that much prominence, the seven heads of state are expected to at least sanction the idea. Some sort of official boost, the Japanese feel, will be needed for their Finance Ministry to approve funding of $40 million for the first full year, beginning in 1989.

The Japanese believe the program is also the key to Japan's new international thrust in basic research. It has been the official economic and scientific policy of Prime Minister Noboru Takeshita's administration to end its almost total reliance on the West for progress in basic research and to transform Japan into an international research power in its own right.

Japan—specifically the Ministry for International Trade & Industry (MITI)—has been trying to shape such a program for the past three years and has called on Western science leaders for help. MITI's early plan included not only brain function and reproductive science, but also immunology, endocrinology, aging, all aspects of metabolism, and in the early plan's words, "integration of various functions."

Kingsbury: open international activity

Funding estimates ran to $600 million for a single year; spending comparisons were made to America's Strategic Defense Initiative. But it also sowed distrust in the West and some infighting between MITI and Japan's Science & Technology Agency, which had its own Frontier Science Program, much smaller in scope but also international in purpose.

Western countries, Washington sources say, didn't like the idea of MITI funding it. Not only did MITI not have any biological research facilities of its own (except for a fermentation research center), but it also had a sullied reputation in the West as the agency that targeted Western technologies for defeat on the commercial battlefield. MITI, it was feared, would raid biological and pharmaceutical laboratories in the West just as it did the electronics research field, essentially monopolize the new era of drug therapy, and as a bonus apply Western brain research to commercial developments in artificial intelligence.

So when the Japanese encountered Western cynicism, they regrouped and took a more modest tack. They assembled an international feasibility study group to design a more attractive model. Discussions between the Japanese and Western scientists have been pro-

Improved Science Education Is Goal of Revived NSF Education Unit

After having been eliminated by budget cuts in 1982, reconstituted education directorate is back at work on key education programs

Pamela S. Zurer, C&EN Washington

Science education has come back to life at the National Science Foundation. Pruned back sharply just a few years ago, the agency's directorate for science and engineering education had gone dormant. Now, carefully nurtured by its energetic assistant director, Bassam Z. Shakhashiri, and well fertilized by Congress, education programs are flourishing again.

In the spring of 1982, with the budget-cutting Reagan Administration choosing to concentrate on funding basic scientific research, NSF abolished its education directorate. The agency all but abandoned its support for science education, which had been a major mission since NSF was launched in 1952.

Educational programs—which in the panic years after the Soviet Union launched the satellite Sputnik accounted for close to half of the agency's funds—were whittled away to nothing. Only an office of scientific and engineering personnel and education remained, charged with administering graduate fellowships and awards.

But, amid growing feeling that the future of the U.S. was threatened by the weak state of U.S. education in general, the directorate for science and engineering education was re-established in the fall of 1983. The directorate's budget since has been growing even faster than that of NSF as a whole. This year the education directorate accounts for about 8% of the total NSF budget, about the same share it commanded in the late 1970s. Congress appropriated $139 million for science and engineering education in fiscal 1988, an increase of 41% from the previous year and $24 million more than the Administration requested.

Shakhashiri came to the directorate in 1984 from the University of Wisconsin, Madison, where as chemistry professor he founded the Institute for Chemical Education. He believes fostering good science education for those students who will not become scientists or engineers is just as important a goal for NSF as is ensuring a good supply of technically trained people.

"In my opinion, the situation we face now in this country is more critical and more consequential than what we faced in the immediate post-Sputnik era," Shakhashiri says. "We now live in a much more advanced scientific and technological society than we did 30 years ago. It's the education in science and in technology of the nonspecialist that we have to pay attention to. We need an enlightened citizenry that can tell the difference between astronomy and astrology. We need a citizenry that understands the beneficial uses of chemicals, that does not associate the word chemical with something bad."

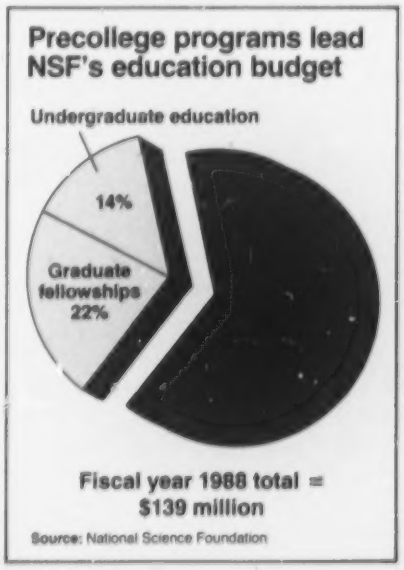
Shakhashiri points to a recent international science achievement survey as evidence that U.S. science education is in sad shape. Students at the fifth, ninth, and 12th grade levels in the U.S. performed poorly in science subjects in comparison with children in other countries.

"I think this is a very, very dismal situation," Shakhashiri says. "I don't believe for one second that the raw talent in this country is any different than it is anywhere else in the world. Yet these data show that there are serious problems that we have to pay very strong attention to now—not tomorrow, or the day after tomorrow."

Accordingly, most of the growth in the education directorate during Shakhashiri's tenure has been in programs targeted at precollege education. "Those are the critical years when attitudes toward science begin to develop and to harden," Shakhashiri says. This year, roughly half of the $90 million precollege budget will be spent on high school projects and the other half directed toward elementary and middle school science education.

The directorate's precollege activities use two strategies. One approach aims at increasing the knowledge base and pedagogical skills of teachers, many of whom are inadequately trained in science. Another set of programs is directed toward developing curriculum-related materials to be used by students.

For instance, NSF has just awarded



Shakhashiri: Chemists must get more involved in education

Bassam Z. Shakhashiri, head of the National Science Foundation's education directorate, feels strongly that scientists in general—and chemists in particular—should become more heavily involved in both formal and informal science education. Attracting more people into the sciences and fostering an appreciation for science and technology in nonscientists are crucial to ensuring a supportive environment for science in the U.S., he thinks.

"The educational reform movement of the past five years has resulted in a great deal of change," Shakhashiri says. "Many states now have increased their graduation requirements for science and for mathematics. But the scientific community has got to get into the act in a much stronger fashion to help define what the content is of those courses that have been put in place and how they can be taught better.

"We need to work very carefully in a collaborative way—that is, we the scientific community and the education community. We can't just say this is something the school of education has to face or the school system has to face. This is something that involves science.

"Why isn't there more discussion—or more action, not just discussion—on the part of chemists in terms of chemistry education? What does it mean to be chemically literate? Shouldn't the chemists get together and debate and decide what that means? Should it mean [simply] that people know the formula of sugar and the formula of sodium chloride? No, it shouldn't mean that.

"Chemists ought to take a very strong, aggressive stand on a variety of these issues. I think we—and when I say we, I mean the chemists—ought to take a very hard look at chemistry and how it's taught in schools and how it is taught in informal settings, whether it's museums or science centers or the media.

"You know how it is, the public does not use the word chemical by itself—it's 'toxicchemical,' one word. The public's perception of chemistry and chemicals and chemists has got to be worked on by the chemists, not by somebody else. We live in a chemical world, yet the chemists are not as forceful as I think they ought to be in communicating chemistry to nonchemists.

"Looking at the national needs as they exist now, I'd like the chemists to take the lead and to plunge into these activities. I think the American Chemical Society and chemistry in general should exercise a great deal of leadership in this regard. It's the responsibility of the chemists because it is their chemistry, their science, that needs to be shared.

"ACS is a very large, very distinguished organization. Yet I'd like to see it improve a great deal in terms of the attention it pays to these kinds of problems. ChemCom [the ACS-developed Chemistry in the Community high school course that takes a nontraditional approach to teaching the traditional concepts of chemistry] is a very important project that we have supported. But it is the only curriculum development project. I'm a strong supporter of ChemCom; I think it will do a great deal of good. But it should not be the only effort. The chemistry community should not sit back and say, 'Aha, we've done our part.'

C&EN staff photo

"National Chemistry Day was a great idea. Why don't we have National Chemistry Day every month? I know it takes a lot of effort to organize these activities, but part of ACS's leadership role is to provide platforms and forums for local sections and other groups to do the kinds of activities that need to be done.

"I want to be sure that the attitudes that chemists have toward chemistry are communicated to everyone. We've got to convey our sense of excitement and commitment that we feel so strongly about."

$7.2 million in four grants to develop new elementary school science materials. The program is designed to foster partnerships among textbook publishers, school systems, scientists, and science educators to improve content and provide more hands-on activities for students. Another $12 million for the projects is coming from the publishers involved, who will market the new curricula and set aside a share of the profits for training teachers in their use. The agency currently is soliciting proposals for a similar program aimed at middle schools, and next year will add high schools.

Other programs in the division of materials development, research, and informal science education are aimed at applying advanced technologies like interactive videodiscs to science teaching. The division also supports research into how certain concepts are learned and how they best can be taught, and it provides partial funding for the children's science and math television programs "3-2-1 Contact" and "Square One."

A new program in the division of research career development is aimed at giving secondary school students research experience in science, math, and engineering during summers and weekends. The $3.7-million "Young Scholars Program" will give more than 2500 high-potential students a chance to participate in ongoing research projects with academic or industry scientists.

Other new NSF education programs are aimed at improving teaching and curricula at the undergraduate level and encouraging women and minorities to undertake careers in science and engineering. "NSF's role is one of leadership and leveraged support," Shakhashiri says. "We can't pay the bill for everything, but we can try to point the way to solutions." □